

```
In [1]: import math
import numpy as np
import pandas as pd
```

```
In [2]: letter_frequencies = {
    "A": 0.082, "B": 0.015, "C": 0.028, "D": 0.043, "E": 0.127, "F": 0.022,
    "G": 0.020, "H": 0.061, "I": 0.070, "J": 0.002, "K": 0.008, "L": 0.040,
    "M": 0.024, "N": 0.067, "O": 0.075, "P": 0.019, "Q": 0.001, "R": 0.060,
    "S": 0.063, "T": 0.091, "U": 0.028, "V": 0.010, "W": 0.023, "X": 0.001,
    "Y": 0.020, "Z": 0.001,
}
```

```
In [3]: ciphertext_1='ZDVOGZIMKGYZFDVDDVXUBPA'
```

```
In [118]... ciphertext_2=''FEWCNWQBMSNSTEJYWOTMXDGVXYCVCYYODSGDQEUOFOTNBAUDQEDKLKDYWEQPJLKF
```

```
In [157]... ciphertext_3='DOEESFDAWTSRJSXSHRZFHJGBIEAGIEOIGKWYANVWKVPHAAGYKNZLVVJBTUYPQROWRE
```

```
In [75]: def frequency_calculator(text):
    frequencies=dict()
    for letter in text:
        if letter not in frequencies.keys():
            frequencies[letter]=1
        else:
            frequencies[letter]+=1
    for letter in frequencies.keys():
        frequencies[letter]=frequencies[letter]/len(text)
    return dict(sorted(frequencies.items()))
```

```
In [32]: def tonum(char):
    "Converts a letter of the alphabet into a number in the range 0..25"
    return ord(char) - 65 # 65 is the ASCII code for the letter A
def tochar(num):
    "Converts a number in the range 0..25 into a letter of the alphabet"
    return chr(num + 65) # 65 is the ASCII code for the letter A
```

```
In [121]... def vigenere_decrypt(text, key):
    key=key.upper()
    length=len(key)
    decrypted=[]
    for index, letter in enumerate(text):
        decrypted.append(tochar((tonum(letter)-tonum(key[index%length]))%26))
    return ''.join(decrypted)
```

```
In [134]... vigenere_decrypt(ciphertext_1, 'VIRGO')
```

Out[134]... 'EVEISEAVESDRIPPINGONUS'

```
In [138]... def vigenere_key(text, length):
    key_array=[]
    for i in range(length):
        dot_product=[]
        frequencies=frequency_calculator(text[i::length])
        for j in range(26):
            shifted=dict()
            for key in letter_frequencies.keys():
                shifted[tochar((tonum(key)+j)%26)]=letter_frequencies[key]
            dot_product.append(sum(shifted[key]*frequencies.get(key,0) for key in
            key_array.append(tochar(dot_product.index(max(dot_product))))
    return ''.join(key_array)
```

```
In [139]... vigenere_key(ciphertext_2,4)
```

Out [139... 'JACK'

In [140... `vigenere_decrypt(ciphertext_2, 'JACK')`

Out [140... 'WEUSEWORDSLIKEHONORCODELOYALTYWEUSETHESEWORDSASTHEBACKBONEOFALIFESPENTDEFENDING
SOMETHINGYOUUSETHEMASAPUNCHLINEIHAVENEITHERTHETIMENORTHEINCLINATIONTOEXPLAINMYSE
LFTOAMANWHORISESANDSLEEPSUNDERTHEBLANKETOFTHEVERYFREEDOMTHATIPROVIDEANDTHENQUEST
IONSTHEMANNERINWHICHIPROVIDEIT'

In [154... `def vigenere_length(text, length=20):
 length_array=[]
 for i in range(1, length):
 shifted=''.join([' '*i+list(text)])
 length_array.append(sum(x==y for x,y in zip(text, shifted)))
 return length_array.index(max(length_array))+1`

In [158... `vigenere_length(ciphertext_3, length=20)`

Out [158... 6

In [159... `vigenere_key(ciphertext_3, 6)`

Out [159... 'WATSON'

In [160... `vigenere_decrypt(ciphertext_3, "WATSON")`

Out [160... 'HOLMESHADBEENSEATEDFORSOMEHOURSINSILENCWITHHISLONGTHINBACKCURVEDOVERACHEMICALV
ESSELINWHICHHEWASBREWINGAPARTICULARLYMALODOROUSPRODUCTHISHEADWASSUNKUPONHISBREAS
TANDHELOOKEDFROMMYPINTOFVIEWLIKEASTRANGELANKBIRDWITHDULLGREYPLUMAGEANDABLACKTOP
KNOTSOWATSONSAIDHESUDDENLYYOU DONOTPROPOSETOINVESTINSOUTHAFRICANSECURITIES'

In []: